

CONTROL UNIT

[0001] The invention relates to a control unit for an electric motor, particularly for an electric motor of an actuator, which is equipped with a control board and a capacitive energy storage device which can be charged by the supply network in order to supply power to the electric motor in the event of a power failure.

[0002] The concerned control unit is particularly suitable for the electric motors of actuators whose outputs are relatively low. Such actuators are used in the safety field, among other fields, in order to, for example, in the event of developing smoke caused by a fire, in the case of a power failure or other emergencies, move an actuator into a position still optimal for the respective case, for example, in order to open or close a flap. Solutions are also known in which the movement into a safety position takes place by mechanical structural elements, such as springs. However, since these mechanical components remain without a function in the normal operation, they may not be operable when a safety situation occurs. Furthermore, it is disadvantageous that the structural element to be adjusted is moved by a purely mechanical drive into an end position which, however, is not necessarily optimal. For the above-mentioned reasons, solutions are therefore preferred which are to be considered as electrical solutions. However, since the possibility exists that the power supply for the electric motor has already failed when the safety function is needed, it is known to supply the electric motor by means of an auxiliary voltage source. Since the electric motors are d.c. motors, an auxiliary voltage source would offer one or more accumulators. However, these auxiliary voltage sources have the disadvantage that over time they discharge in an uncontrolled manner so that the energy still to be supplied will not be sufficient for starting the electric motor.

[0003] It has therefore been suggested to use a capacitive storage device as an energy storage device which is charged from the power supply network. It is an advantage that

the full capacity or energy is always available. It is particularly advantageous for this capacitive storage device to be fed from the circuit of the electric motor. In the case of a known control unit or in the case of a known safety circuit, the capacitive storage device is charged from the power supply network but, in the event that the electric motor has to be supplied from the storage device, a switch, preferably a relay, is switched. This also still results in an uncertainty since this switch or the relay is not operated in the normal operation, so that an operational check also would have to be carried out. In the case of capacitive energy storage devices, the intensity of the supplied current and thus also of the torque applied by the electric motor depends on the ambient temperature. When the electric motor is used for an actuator, depending on the usage case or site, the ambient temperatures fluctuate in a wide range, for example, between -25°C and $+25^{\circ}\text{C}$. At these indicated values, the torque to be applied at a temperature of -25°C amounts to only half the torque which would be applied at a temperature of $+25^{\circ}\text{C}$. However, since a certain torque is required, the capacitive energy storage device has to be designed for the lowest temperature, so that an overdimensioning takes place in many usage cases. In addition, the capacitive energy storage devices are subjected to an aging process. However, this aging process is accelerated, the higher the ambient temperature and the operational voltage. A service life is defined for the considered usages. So that this service life is achieved, care has to be taken that the operational voltage of the capacitive energy storage device will remain under its nominal voltage at temperatures in the upper range, so that the planned service life will be reached.

[0004] The invention is based on the object of designing a control unit of the initially described type such that a temperature-dependent acceleration of the aging process or the reduction of the storage capacity of the capacitive energy storage device is effectively avoided, in which case the length of operation is not decreased by an excess voltage.

[0005] The above object is achieved in that the control unit is equipped with a sensor for determining the ambient temperature or to which a sensor is assigned such that the respectively measured temperature can be converted to control signals by means of a

converter, and in that the charge voltage of the capacitive energy storage device can be controlled as a function of the temperature by means of a voltage converter.

[0006] The ambient temperature for the electric motor is now measured continuously. As a result, it is ensured that, at extremely low and also at extremely high temperatures, a continuously constant or approximately constant torque can be applied by the electric motor since also the operational voltage for the capacitive energy storage device, apart from slight fluctuations, is always constant. As a result, neither a temperature-dependent nor a voltage-dependent aging process is promoted. Therefore, the previously necessary overdimensioning is eliminated since it is to be assumed that the considered control unit is used in many different temperature ranges with extremely different temperatures. By means of the above-described measures, not only the defined service life of the capacity energy storage device is reached but the stored energy is also sufficient so that the electric motor will deliver a sufficient driving torque.

[0007] The implementation of the voltage control can take place in multiple manners. Thus, it is provided that the operational voltage for the capacitive energy storage device can be controlled by means of a charge converter as a function of the temperature to a constant or approximately constant value. Constructively, the control unit is particularly simple but is also offers a high operational reliability if the capacitive energy storage device is constantly acted upon by its respective operational voltage. As a result, the charge condition becomes constant so that the electric motor can be supplied with current from the capacitive energy storage device at any time. The temperature sensor or temperature probe may be arranged outside the control unit. However, in a preferred embodiment, it is provided that the temperature sensor is integrated in the control board. As a result, lines to the control unit are avoided. Furthermore, the temperature sensor or temperature probe would be protected.

[0008] The capacitive energy converter should expediently be arranged within the electrical circuit of the motor, because the lower motor voltage then has to be controlled. Normally, the considered electric motors are also acted upon by means of a direct safety

current. The electric motor could then directly, if required, be acted upon by the voltage from the capacitive energy storage device. If the capacitive energy storage device is not acted upon by means of voltage from the motor circuit, it is provided that, if the electric motor is acted upon by voltage from the energy storage device, the voltage can be converted by means of a discharge converter.

[0009] The invention will be explained in detail by means of the attached drawing.

[00010] Figure 1 is a conceivable block diagram for implementing the control unit according to the invention.

[00011] For reasons of a simpler representation, Figure 1 shows only the block diagram because the used electrical and electronic components are known. The control unit 10 is equipped with a device control 11 into which the values are fed which are measured by means of a temperature sensor 12 or a temperature probe. As illustrated by the arrow A, the device control 11 is acted upon by means of voltage. The intensity of the voltage may be the normal line voltage, and a transformer and a rectifier may be installed in the device control in order to convert a normal alternating voltage to a direct safety voltage. However, it is also conceivable that the transformer is mounted outside the device control 11, so that the direct safety voltage is fed into the device control 11. The block diagram indicates that two electric circuits flow out of the device control 11, specifically an electric circuit for acting upon the electric motor M and another electric circuit for acting upon the capacitive energy storage device C. A charge converter 13 is also installed in this electric circuit and controls the outgoing current as a function of the temperature to a constant or approximately constant value. As a result, the capacitive energy storage device C is always acted upon by the same or approximately the same charge voltage or operational voltage. The voltage is therefore present at the energy storage device C. In the event of a power failure, the motor M is either directly acted upon from the capacitive energy storage device C, or the voltage is, in addition, converted by way of a discharge converter 14.

[00012] In a manner not shown in detail, the device control 11 is equipped with a control board which may also contain the temperature sensor 12 or the temperature probe.

[00013]

The invention is not limited to the illustrated embodiment. It is important that the ambient temperature of the electric motor M is determined and that the charge voltage of the capacitor C is always constant or approximately constant, even if the ambient temperatures fluctuate to an extreme degree or are different. For this purpose, the control unit is also equipped with a charge converter 13.